Scheme of Teaching, Examination and Syllabus

B.E. COMPUTER SCIENCE AND ENGINEERING

Batch: 2021-22

Fourth Year
(VII and VIII SEMESTER)

(Effective from the academic year 2024-2025)

SreeSiddaganga Education Society®

Siddaganga Institute of Technology

(An Autonomous institute affiliated to Visvesvaraya Technological University, Belagavi)
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SCHEME OF TEACHING AND EXAMINATION (160 Credits Scheme)

(Effective from the academic year 2024-2025)

B.E. in Computer Science & Engineering — Batch:2021-2022

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
VII Semester													
1.	PCC	N7CS01	Cryptography & Cyber Security	CS	3	0	0	3.5(48 hrs)	3	50	50	100	3
2.	PEC	N7CSPE2x	Professional Elective Course-II	CS	3	0	0	3.5(48 hrs)	3	50	50	100	3
3.	PEC	N7CSPE3x	Professional Elective Course-III	CS	3	0	0	3.5(48 hrs)	3	50	50	100	3
4.	OEC	NOE71	Open Elective Course-II		3	0	0	3.5(48 hrs)	3	50	50	100	3
5.	AEC	RMIP	Research Methodology & Intellectual Property Rights		2	0	0	2.0(32 hrs)	3	50	50	100	2
6.	Project	CSP	Project Work	CS	Monday to Thursday shall be earmarked for carrying out Project work				3	100	100	200	10
			Total							**350**	**350**	**700**	**24**
		AAP	AICTE Activity Points		40 hours community service to be documented and produced for the examination								
VIII Semester													
1.	Seminar	CSTS	Technical Seminar		One contact hour /week for interaction between the faculty and students.					100	--	100	1
2.	Internship	INT3	**INTERNSHIP – III** (Research/Industry Internship)		Two contact hours /week for interaction between the faculty and students.					100	100	200	15
3.	NCMC		National Service Scheme (NSS)	NSS	Completed during III semester to VIII semester.					50	50	100	0
			Physical Education (PE) (Sports and Athletics)	PE									
			Yoga	Yoga									
			NCC	NCC									
			Total							**250**	**150**	**400**	**16**
		AAP	AICTE Activity Points							**100**	**---**	**100**	**0**

Professional Elective -II		**Professional Elective - III**	
N7CSPE21	Blockchain Technology	N7CSPE31	Natural Language Processing
N7CSPE22	Deep Learning	N7CSPE32	Internet of things
N7CSPE23	Parallel Computing	N7CCSPE01	Generative AI & Prompt Engineering
N7CSPE24	Computer Graphics & Image Processing	N7CCSPE02	Real Time Big Data Analytics

Note: **PCC**: Professional Core Course, **PEC**: Professional Elective Course, **OEC** –Open Elective Course, **AEC** –Ability Enhancement Course

L –Lecture, **T** – Tutorial, **P-** Practical/ Drawing, **S** – Self-Study Component, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Examination

PROJECT WORK (XXP): The objective of the Project work is

(i) To encourage independent learning and the innovative attitude of the students.
(ii) To develop interactive attitude, communication skills, organization, time management, and presentation skills.
(iii) To impart flexibility and adaptability.
(iv) To inspire team working.
(v) To expand intellectual capacity, credibility, judgment and intuition.
(vi) To adhere to punctuality, setting and meeting deadlines.
(vii) To instill responsibilities to oneself and others.
(viii) To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

CIE procedure for Project Work:

(1) **Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the project work, shall be based on the evaluation of Project Work Report, Project Presentation Skill, Question & Answer session and Guide Assessment in the ratio 40:20:20:20. The marks awarded for the project report shall be the same for all the batch mates.

(2) **Interdisciplinary:** Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the project. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of Project Work Report, Project Presentation Skill, Question & Answer session and Guide Assessment in the ratio 40:20:20:20. The marks awarded for the project report shall be the same for all the batch mates.

SEE procedure for Project Work:

SEE for project work will be conducted by the two examiners appointed by the Chairman-BoE. The SEE marks awarded for the project work, shall be as per the Table mentioned below:

Project Report	25
Presentation & Demonstration	30
Quality of Work	25
Viva-Voce (Q&A Session)	20
Total	**100**

Note: VII and VIII semesters of IV year of the programme

(1) Departments can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester.
(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the programme.

TECHNICAL SEMINAR (XXTS):

The objective of the seminar is to inculcate self-learning, present the seminar topic confidently, enhance communication skill, involve in group discussion for exchange of ideas. Each student, under the guidance of a Faculty, shall choose, preferably, a recent topic of his/her interest relevant to the programme of Specialization.

(i) Carry out literature survey, systematically organize the content.
(ii) Prepare the report with own sentences, avoiding a cut and paste act.
(iii) Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities.
(iv) Present the seminar topic orally and/or through PowerPoint slides.
(v) Answer the queries and involve in debate/discussion.
(vi) Submit a typed report with a list of references.

The participants shall take part in the discussion to foster a friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Evaluation Procedure:

The CIE marks for the seminar shall be awarded by Department Seminar Evaluation Committee DSEC (based on the relevance of the topic, presentation skill, participation in the question and answer session, and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three teachers from

the department with the senior-most acting as the Chairman.

Marks distribution for CIE of the course is as shown in Table below:

Relevance of the topic	10 marks
Report	20 marks
Presentation	30 marks
Viva-Voce	20 marks
Guide Assessment	20 marks
Total	**100 marks**

No SEE component for Technical Seminar.

Non-Credit Mandatory Course (NCMC):

National Service Scheme/Physical Education (Sport and Athletics)/Yoga:

(1) Securing 40 % or more in CIE, 35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they have to appear for SEE during the subsequent examinations conducted by the University.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks.

(4) Successful completion of the course shall be indicated as PP in the grade card. Non-completion of the course shall be indicated as NP.

(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

AICTE Activity Points:

Apart from technical knowledge and skills, to be successful as professionals, students should have excellent soft skills, leadership qualities and team spirit. They should have entrepreneurial capabilities and societal commitment. In order to match these multifarious requirements, AICTE has created a unique mechanism of awarding minimum 100 Activity Points for regular students and 75 Activity Points for Lateral Entry students over and above the academic grades.

The activities can be spread over entire duration of the programme and it will be reflected in the Student's VIII Semester Grade Card. It shall not be considered for computation of SGPA/CGPA and for vertical progression. The total duration of the activities for entire programme is 320 hours for regular students and 240 hours for lateral entry students.

Break-up of CIE marks for activity points:

Evaluation by the Proctor	50 marks
Evaluation by DSEC	
(i) Report	20 marks
(ii) Presentation	20 marks
(iii) Outcome	10 marks
Total	**100 marks**

1. No SEE for AICTE Activity Points.
2. Students will be awarded either NP or P grade based on marks obtained..
3. Students will be awarded 'Degree' only on earning P grade in the Activity Points.

Scheme of Teaching, Examination and Syllabus

B.E. COMPUTER SCIENCE & ENGINEERING

Batch: 2021-22

VII SEMESTER

(Effective from the academic year 2024-2025)

B.E COMPUTER SCIENCE & ENGINEERING
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – VII

CRYPTOGRAPHY & CYBER SECURITY

Course Code	**N7CS01**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03
Lecture Hours	40 Hrs	Practical Hour	-

Course objectives: The course will enable students to

1. Illustrate the understanding of Cyber Security Fundamentals (Comprehension).
2. Analyses the attacker motivation and the techniques used by them to break the security of the application (Analyses and Application).
3. Study the vulnerabilities in applications and networks. Analyses the possible attacks that can be built by the hackers (Analyses and Application).
4. Evaluation of Malicious code and analysis of attacks against Privileged User Accounts (Analysis and Evaluation)
5. Analysis of Defence Techniques for Cyber Security. (Analysis).

UNIT-1 **(10 hrs)**

Cyber Security Fundamentals: Network and Security Concepts, Information Assurance Fundamentals, Basic Cryptography, Symmetric Encryption, Public Key Encryption.

Cryptographic Data Integrity Algorithms: Cryptographic Hash Functions:Applications of Cryptographic hash functions, Two simple hash Functions, Secure Hash Algorithm.

MESSAGE AUTHENTICATION CODES: Authentication Requirements, Authentication Functions, Requirements for Message Authentication Codes, Security of MACs, MACs based on Hash Functions:HMAC.

Digital Signatures: Digital Signatures, NIST Digital Signature Algorithm.
The Domain Name System (DNS), Firewalls.

UNIT-2 **(06hrs)**

Attacker Techniques and Motivations:
How Hackers Cover Their Tracks (Anti-forensics), How and Why Attackers Use Proxies, Tunneling Techniques, Fraud Techniques, Phishing, Smishing, Vishing and Mobile Malicious Code, Rogue Anti-Virus, Click Fraud, Threat Infrastructure, Botnets, Fast-Flux, Advanced Fast-Flux

UNIT-3 **(09 hrs)**

Exploitation: Techniques to Gain a Foothold, Shellcode, Integer Overflow, Vulnerabilities, Stack-Based Buffer Overflows, Format-String Vulnerabilities, SQL Injection, Malicious PDF Files, Race Conditions, Web Exploit Tools, DoS Conditions, Brute-Force and Dictionary Attacks, Misdirection, Reconnaissance and Disruption Methods, Cross-Site Scripting (XSS), Social Engineering, WarXing, DNS Amplification Attacks.

UNIT-4 **(08 hrs)**

Malicious Code: Self-Replicating Malicious Code, Worms, Viruses, Evading Detection and Elevating Privileges, Obfuscation, Virtual Machine Obfuscation, Persistent Software Techniques, Rootkits, Spyware, Attacks against Privileged User Accounts and Escalation of Privileges, Token Kidnapping, Virtual Machine Detection, Stealing Information and Exploitation, Form Grabbing, Man-in-the-Middle Attacks, DLL Injection, Browser Helper Objects.

UNIT-5 **(06 hrs)**

Defense and Analysis Techniques: Memory Forensics, Why Memory Forensics Is Important, Capabilities of Memory Forensics, Memory Analysis Frameworks, Dumping Physical Memory, Installing and Using Volatility, Finding Hidden Processes, Volatility Analyst Pack, Honeypots, Malicious Code Naming, Automated Malicious Code Analysis Systems, Passive Analysis, Active Analysis, Physical or Virtual Machines, Intrusion Detection Systems, Cyber Security Essentials.

Open Source Security Tools:
Port Scanners: Installing Nmap on Linux and windows
Intrusion Detection Systems: Unique Features of Snort, Configuring Snort for Maximum performance.

Analysis and Management Tools: Using Databases and Web Servers to Manage Your Security Data.

Forensic Tools: Preparing for Good Forensic, Forensic Analysis Tools, Making Copies of Forensic and Creating and Logging into a Case

Course outcomes:

After the completion of the course, students will be able to

1. Apply the cryptographic concepts underlying Cyber Security.
2. Analyze the techniques used by hackers to create frauds
3. Analyze the vulnerabilities in a network or in an application that will help hackers to build the attack.
4. Analyze various types of malicious codes and security tools
5. Demonstrate Memory Forensics as a defense technique for Cyber Security.
6.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Cyber Security Essentials	James Graham, Richard Howard, Ryan Olson	CRC Press	2011
2	Cryptography and Network Security (Chapters 11.1-11.2,11.5,12.1-12.5,13.1,13.4).	William Stallings	Prentice Hall of India,	Seventh Edition,2017
3	Open Source Security Tools Practical Applications for Security	Tony Howlett	Open Source	2004
	http://ptgmedia.pearsoncmg.com/images/0321194438/downloads/0321194438_book.pdf UNIT-5 Open Source Security tools: Chapter: 4, 7, 8 and 11 section from these chapters.			
Reference Books				
1	Cyber security: turning national solutions into international cooperation	James A. Lewis	CSIS Press, Center for Strategic and International Studies	2003

2	Cyber security: The Essential Body of Knowledge.	Dan Shoemaker, Ph.D., William	Cengage Learning	2011
3	Cyber security Operations Handbook	John Rittinghouse, PhD, William	Elsevier Digital Press	2003

COURSE ARTICULATION MATRIX															
Course Outcomes	**PROGRAMME OUTCOMES**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
CO1	2		2												2
CO2		2			2										2
CO3		2													2
CO4		2													2
CO5		2			2										2
Overall CO	2	2	2		2										2
PROGRAM ARTICULATION MATRIX															
Course Outcomes	**PROGRAMME OUTCOMES**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
Overall CO	2	2	2		2										2

B.E COMPUTER SCIENCE & ENGINEERING
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – VII

BLOCKCHAIN TECHNOLOGY

Course Code	**N7CSPE21**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03
Lecture Hours	40 Hrs	Practical Hour	-

Course objectives: The course will enable students to

1. Comprehend the fundamentals of Blockchain and its organization.
2. Describe the underlying concepts of working of a Blockchain.
3. Infer the working principle of Bitcoin.
4. Interpret the working of Blockchain using Ethereum.
5. Examine possible business applications of Blockchain..

UNIT-1 **(08 hrs)**

Introduction to Blockchain, Backstory of Blockchain, What is Blockchain?, Centralized vs. Decentralized Systems, Centralized Systems, Decentralized Systems, Layers of Blockchain, Application Layer, Execution Layer, Semantic Layer, Propagation Layer, Consensus Layer, Why is Blockchain Important?, Limitations of Centralized Systems, Blockchain Adoption So Far, Blockchain Uses and Use Cases

T1 – Chapter 1

How Blockchain Works: Laying the Blockchain Foundation, Cryptography: Symmetric Key Cryptography, Cryptographic Hash Functions,MAC and HMAC,Asymmetric Key Cryptography, Diffie-Hellman Key Exchange,Symmetric vs. Asymmetric Key Cryptography.

T1 – Chapter 2

UNIT-2 **(08 hrs)**

Game Theory: Nash Equilibrium, Prisoner's Dilemma, Byzantine Generals' Problem, Zero-Sum Games, Why to Study Game Theory,

Computer Science Engineering, The Blockchain, Merkle Trees,

Putting It All Together, Properties of Blockchain Solutions, Blockchain Transactions, Distributed Consensus Mechanisms, Blockchain Applications, Scaling Blockchain, Off-Chain Computation, Sharding Blockchain State

T1 – Chapter 2

UNIT-3 **(08 hrs)**

The History of Money, Dawn of Bitcoin, What Is Bitcoin?, Working with Bitcoins, The Bitcoin Blockchain, Block Structure, The Genesis Block, The Bitcoin Network, Network Discovery for a New Node, Bitcoin Transactions, Consensus and Block Mining, Block Propagation, Putting It all Together, Bitcoin Scripts, Bitcoin Transactions Revisited, Scripts, Full Nodes vs. SPVs, Full Nodes, SPVs

T1 – Chapter 3

UNIT-4 **(08 hrs)**

From Bitcoin to Ethereum, Ethereum as a Next-Gen Blockchain, Design Philosophy of Ethereum, Enter the Ethereum Blockchain, Ethereum Blockchain, Ethereum Accounts, Trie Usage, Merkle Patricia Tree, RLP Encoding, Ethereum Transaction and Message Structure, Ethereum State Transaction Function, Gas and Transaction Cost, Ethereum Smart Contracts, Contract Creation, Ethereum Virtual Machine and Code Execution, Ethereum Ecosystem, Swarm, Whisper, DApp, Development Components

T1 – Chapter 4

UNIT-5 **(08 hrs)**

Propelling Business with Blockchains , Recognizing Types of Market Friction, Information frictions, Interaction frictions, Innovation frictions, Moving Closer to Friction-Free Business Networks, Reducing information friction, Easing interaction friction, Easing innovation friction, Transforming Ecosystems through Increased Visibility, Blockchain in Action: Use Cases Financial Services, Trade finance, Post-trade clearing and settlement, Cross-border transactions, Trusted digital identity, Multinational Policy Management, Government, Supply Chain Management, Food safety, Global trade, Healthcare, Electronic medical records, Healthcare payment preauthorization

T2 – Chapter 3 & 4

Course outcomes:

On successful completion of this course, students will be able to:

1. Apply the knowledge of Cryptography and distributed systems to describe the concepts of Blockchain, its structure and working.
2. Apply the knowledge of Data structures and Game theory to describe the processing of blockchain transactions and consensus mechanisms.
3. Analyse the working of Bitcoin cryptocurrency with the associated scripts and infrastructure
4. Describe the working of Ehereum blockchain and develop a suitable application on Ethereum blockchain platform
5. Identify potential business use cases of Blockchain in various sector and analyse its impact.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Beginning Blockchain ISBN 9781484234433	Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda	Apress Media	2018
2	Manav Gupta	Blockchain For Dummies,	John Wiley & Sons,	2nd IBM Limited Edition
Reference Books				
1	Blockchain for Business 2019	Peter Lypovonyav	Packt Publishing Limited,	2019
2	Ethereum for Architects and Developers	Debajani Mohanty	Apress Media, 2018, ISBN 9781484240748	2018

Course Articulation matrix(CO-PO and CO-PSO mapping)

Course Outcomes	PROGRAMME OUTCOMES												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO1	2													2	
CO2	2													2	
CO3		2												2	
CO4			2		2									2	
CO5		2												2	
Overall CO	2	2	2		2									2	

B.E COMPUTER SCIENCE & ENGINEERING
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – VII

DEEP LEARNING

Course Code	**N7CSPE22**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03
Lecture Hours	40 Hrs	Practical Hour	-

Course objectives: The course will enable students to

1. Learn deep learning methods for working with sequential data
2. Learn deep recurrent and memory networks
3. Apply deep learning mechanisms to various learning problems.
4. Learn various performance metrics to evaluate deep learning models and apply the same to real world problems...

UNIT-1 **(08 hrs)**

Introduction to AI, Machine Learning, and Deep Learning, Definitions and differences, Real-world applications, The Evolution of Machine Learning, From probabilistic models to neural networks, Key milestones in ML history, Understanding Deep Learning, Key concepts and terminology, Why & quot ; deep & quot ; ? The role of multiple layers, Current Achievements and Future Directions, Notable successes, The hype vs. the reality, Future trends and predictions, Data Representations for Neural Networks, Scalars, vectors, matrices, and tensors, Real-world examples, Tensor Operations, Element-wise operations, Broadcasting, Tensor reshaping, Gradient-Based Optimization, Derivatives and gradients.

UNIT-2 **(08 hrs)**

Overview of TensorFlow and Keras, History and development, Key features and components, Basic TensorFlow Operations, Constant tensors and variables, Basic mathematical operations, Practical Exercise: Linear Classifier in TensorFlow, Building and training a simple linear classifier, Building Blocks of Neural Networks, Layers, models, and the compile step, Choosing Loss Functions and Metrics, Different types of loss functions, Metrics for evaluation, Training and Evaluating Models, The fit() method, Monitoring loss and metrics, Inference and Model Usage, Making predictions.

UNIT-3 **(08 hrs)**

Binary Classification, Regression Analysis, K-fold validation and model evaluation, multiclass classification, and regression, Generalization, Underfitting, and Overfitting, Strategies to avoid overfitting, Model Evaluation Techniques, Training, validation, and test sets, Beating a baseline, Improving Model Fit, Tuning gradient descent parameters, Architectural improvements, Improving Generalization, Data curation and feature engineering, Early stopping and regularization techniques.

UNIT-4 **(08 hrs)**

Basics of Convolutional Neural Networks, Convolution and pooling operations, Training ConvNets from Scratch, Small dataset challenges and solutions, Data Augmentation Techniques, Enhancing training datasets, Image Segmentation,Techniques and applications, Modern ConvNet Architectures, Residual connections, Batch normalization and depthwise separable convolutions, Interpreting ConvNet Outputs, Visualizing intermediate activations and filters, Generating class activation heatmaps.

UNIT-5 **(08 hrs)**

Time Series Data and Tasks, Types and challenges, Use cases, Temperature Forecasting Example, Data preparation and model building, Recurrent Neural Networks (RNNs), Basic and advanced RNN techniques, Practical Exercise: Implementing RNNs, Building and training RNNs for time series forecasting,Introduction to Generative Adversarial Networks (GANs), GAN architecture and training.

Course outcomes:

On successful completion of this course, students will be able to:

1. Describe basic concepts of neural network, its applications and various learning models
2. Acquire the knowledge on Recurrent, Recursive Nets
3. Analyze different Network Architectures, learning tasks, Convolutional networks
4. Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
5. Analyze performance of deep learning techniques

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Deep Learning with Python	François Chollet	Manning Publications Co, ISBN: 9781617296864.	2nd Edition
2	Deep Learning for Coders with fastai & PyTorch	Jeremy Howard & Sylvain Gugger Foreword by Soumith Chintala	O'reilly, ISBN:978-1-492-04552-6	
Reference Books				
1	Neural Networks – A Comprehensive Foundation, Simon Haykin	Simon Haykins	PHI,	2nd Edition, 2005
2	Introduction to Artificial Neural Networks, Gunjan Goswami, S.K. Kataria & Sons	Gunjan Goswami, S.K. Kataria & Sons	ISBN-13: 978-9350142967.	1st Edition , 2012
3	Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms, Nikhil Buduma	Nikhil Buduma	O'Reilly Publications,	2016

Course Articulation matrix(CO-PO and CO-PSO mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	3	1	1	2	2	2	1	3
CO2	3	3	3	2	3	1	1	1	2	2	2	3
CO3	3	3	3	3	3	2	2	2	3	3	3	3
CO4	3	3	3	3	3	1	2	2	2	2	2	3
CO5	3	2	2	3	3	1	1	2	2	2	2	3

1: Low, 2: Medium, 3: High

B.E COMPUTER SCIENCE & ENGINEERING
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – VII

PARALLEL COMPUTING

Course Code	**NCS7PE23**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03
Lecture Hours	40 Hrs	Practical Hour	-

Course objectives: The course will enable students to

1. To analyse typical parallel algorithm models and its application in scientific computing. (Analysis, Application)
2. To develop programs using message-passing paradigm. (Synthesis)
3. To learn how GPUs works using the CUDA architecture and its applications (Comprehension, Application)
4. To gain practical knowledge by giving hands on experience inGraphics Interoperability, CUDA C on multiple GPUs and CUDA toolkit (Synthesis)
5. To analyze the latest parallel computing techniques and research - prepare a technical document and make a presentation (Analysis, Syntheses and Evaluation)
6. To develop open ended solution for any of the identified high performance computing problems

UNIT-1 **(8 hrs)**

Principles of Parallel Algorithm Design: Preliminaries ,Decomposition Techniques, Characteristics of Tasks and Interactions ,Mapping Techniques for Load Balancing

Basic Communication Operations: One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction

Analytical Modeling of Parallel Programs: Sources of Overhead in Parallel Programs, the Effect of Granularity on Performance

UNIT-2 **(7 hrs)**

Modelling and Visualization:
Visualizing Online Social Networks - A Taxonomy of Visualizations - Graph Representation - Centrality- Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix- Based Representations- Node-Link Diagrams - Hybrid Representations - Modelling and aggregating social network data – Random Walks and their Applications –Use of Hadoop and Map Reduce - Ontological representation of social individuals and relationships.

UNIT-3 **(8 hrs)**

Programming Using the Message-Passing Paradigm:
Principles of Message-Passing Programming, The Building Blocks: Sendand Receive Operations, MPI: the Message Passing Interface

UNIT-4 **(8 hrs)**

Why CUDA? Why Now?: The Age of Parallel Processing, Central Processing Units,The Rise of GPU Computing, A brief history of GPUs, Early GPU computing, CUDA,What is CUDA architecture, using the CUDA architecture, Applications of CUDA,Medical Imaging, Computational Fluid Dynamics, Environmental Science, Introductionto CUDA C: A First Program, Hello world, A kernel call, Passing parameters, Queryingdevices, using device properties, Parallel Programming in

CUDA C:CUDA parallel
programming, Summing vectors, A fun example.

UNIT-5 **(7 hrs)**

Graphics Interoperability: Graphics Interoperation, GPU Ripple with Graphics Interoperability - the GPUAnimBitmap structure; GPU Ripple Redux , Heat transfer with Graphics Interop, DirectX Interoperability

CUDA C ON multiple GPUS : Zero-Copy Host Memory -Zero-Copy Dot Product; Zero-Copy Performance, Using Multiple GPUs, Portable Pinned Memory

CUDA Tools: CUDA Toolkit- CUFFT, CUBLAS, NVIDIA GPU Computing SDK, Debugging CUDA C

Course outcomes:

On successful completion of this course, students will be able to:

1. Select and analyze the characteristics of various parallel computing platforms.
2. Choose a suitable platform for parallel computing.
3. Analyze simple parallel algorithm models.
4. Apply the principles of message-passing programming construct to solve engineering problems.
5. Design and develop parallel programs using CUDA and OpenMp programming interface

Sl. no.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Introduction to parallel computing (chapters 01,2.1-2.5,3,4.1.1-4.1.3, 5.1, 5.2, 5.3, 6,7)	Ananth Grama, AnshulGupta, Vipinkumar,GeorgeKarypis	Pearson education publishers	second edition,2003
2	CUDA by example (Chapters 1 ,3, 4, 5, 8, 11, 12)	Jason Sanders Edward Kandrot	NVIDIA Corporation	2011
Reference Books				
1	Parallel Programming for Multicore and cluster systems	Thomas Rauber and Gudula Runger	Springer	International Edition,2009
2	Computer Architecture: A quantitative Approach	Hennessey and Patterson	Morgan Kaufman	5th edition,2012
3	Parallel Programming in C with MPI and Open MP	Michael J. Quin	McGraw Hill	1st edition,2003

Course Articulation matrix(CO-PO and CO-PSO mapping)

Course Outcomes	PROGRAM OUTCOMES												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO1	2												2		
CO2	2												2		
CO3		2											2		
CO4			2		2								2		
CO5			2		2								2		
Overall CO	2	2	2		2								2		

B.E COMPUTER SCIENCE & ENGINEERING
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – VII

COMPUTER GRAPHICS AND IMAGE PROCESSING

Course Code	**N7CSPE24**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03
Lecture Hours	40 Hrs	Practical Hour	-

Course objectives: The course will enable students to

1. Demonstrate basic understanding of the core concepts of computer graphics
2. Develop programs using OpenGL to achieve visualization in graphical applications
3. Apply engineering knowledge to develop 2D & 3D projections for visualization
4. Apply techniques like rasterization, clipping, hidden surface removal and anti-aliasing for graphical applications
5. Demonstrate use cases using opencv

UNIT-1 **(08 hrs)**

Introduction: Applications of computer graphics, A graphics system, Images: physical and Synthetic, Imaging systems, The Synthetic camera model, Graphics architectures, Graphics programming: the Sierpinski gasket, Programming 2D applications

UNIT-2 **(08 hrs)**

The OpenGL: The OpenGL API, Primitive and attributes, control functions, the Gasket program, Polygons and recursion, The 3D gasket, Plotting implicit functions

UNIT-3 **(08 hrs)**

Input and Interaction: input devices, Display lists: display lists & modeling, Programming event_driven input, Menus: picking: A simple CAD program; Building interactive models, Animating interactive programs;

UNIT-4 **(08 hrs)**

Implementation: Basic implementation strategies, the major tasks, Clipping, line_segment clipping, polygon clipping, Clipping of other primitives, Rasterization, Bresenham's algorithm, Polygon Rasterization, Hidden surface removal, Antialiasing

UNIT-5 **(08 hrs)**

Introduction: What is Digital Image Processing, The origin of digital image processing, Example of fields that use digital image processing, Fundamental steps in digital image processing, Components of an image processing system
Opencv basics, transformations and contours.
Activity: use cases using opencv

Course outcomes:
Upon completion of this course the student will be able to:

1. **Apply** knowledge of graphics concepts, architecture and programming in developing graphical applications.
2. Create, select and **apply** appropriate OpenGL functions, 2D and 3D projections to achieve visualization in graphics designing.
3. **Analyze** and **develop** interactive, animated and event driven graphical solutions with

OpenGL

4. **Analyze** and **apply** the different implementation techniques like rasterization, clipping, hidden surface removal and antialiasing
5. **Apply** basics of computer graphics to get insight into digital image processing

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each UNIT.
- Each full question will have sub- question covering all the topics under a UNIT.
- The students will have to answer five full questions, selecting one full question from each UNIT.

Sl. no.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Interactive Computer Graphics A Top-Down Approach with OpenGL,	Edward Angel	Addison-Wesley"	,5th Edition, ,2008(UNITs 1,2 3 4))
2	Introduction to Computer Graphics,	David J. Eck		version 1.4,2023(UNIT 5)
Reference Books				
1	Computer Graphics Using OpenGL,.	F.S. Hill,Jr.	Pearson education	2nd Edition, 2001
2	Computer Graphics,	James D Foley, Andries Van Dam,	Addison-Wesley.	1997
3	Computer Graphics with OpenGL,	Donald Hearn and	,Pearson Education	4th edition, 2011

Course Articulation matrix(CO-PO and CO-PSO mapping)

COURSE ARTICULATION MATRIX															
Course Outcomes	**PROGRAMME OUTCOMES**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
CO1	1		2											2	
CO2			3											2	
CO3			3											2	
CO4			3											2	
CO5	1		3											2	
Overall CO	1		3												

B.E COMPUTER SCIENCE & ENGINEERING
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – VII

NATURAL LANGUAGE PROCESSING

Course Code	**N7CSPE31**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03
Lecture Hours	40 Hrs	Practical Hour	-

Course objectives: The course will enable students to

1. To Understand the NLP techniques like parsing, POS-tagging and Word sense disambiguation.
2. To explore language modeling techniques such as N-grams.
3. To explore the applications of NLP such as Machine translation, Information retrieval etc.
4. To understand the basic architecture of the NLG system and the role of NLP in a search engine.
5. Demonstrate the use of modern NLP techniques for processing of text like extracting the data. Text to Feature representation etc..

UNIT-1 **(08 hrs)**

Introduction: What is NLP? Origins of NLP, Language and Knowledge, The challenges of NLP, NLP Applications, Some successful Earley NLP systems.

Word level Analysis: Introduction, Regular Expressions, Finite-state Automata, Morphological Parsing.

Extracting the Data: Text data collection using APIs, Reading PDF file in Python, Reading word document, Reading JSON object, Reading HTML page and HTML parsing, Regular expressions, String handling, Web scraping.

Exploring and Processing Text Data: Lowercasing, Punctuation removal, Stop words removal, Text standardization, Spelling correction, Tokenization, Stemming, Lemmatization, Exploratory data analysis, End-to-end processing pipeline.

(Text Book-1: 1.1-1.5,1.7,1.8,3.1-3.4)
(Text Book-2: 1,2)

UNIT-2 **(08 hrs)**

Language Modeling: Introduction, Statistical Language Model- N-gram model, Add-one smoothing, Good-Turing smoothing.

Part-of-Speech Tagging: Rule-based Tagger, Stochastic Tagger, Hybrid Tagger.

Syntactic Analysis: CFG, Parsing- Top-down parsing, Bottom-up parsing, The Earley Algorithm, Probabilistic Parsing- Estimating Rule probabilities.

(Text Book-1: 2.1,2.3,3.7,4.2,4.4.1-4.4.4,4.5.1)

UNIT-3 **(08 hrs)**

Information Retrieval-1: Introduction, Design features of Information Retrieval Systems, Information Retrieval models, Classical Information Retrieval models, Non-classical models of IR, Alternative models of IR, Evaluation of the IR system.

Information Retrieval-2: Natural Language Processing in IR, Cross-Lingual Information Retrieval

Converting Text to Features: One Hot encoding, Count vectorizer, Co-occurrence matrix, Hash vectorizer, Word embedding, Implementing fastText.

Information retrieval using word embeddings.

(Text Book-1: 9.1-9.7,10.2,10.6)
(Text Book-2: 3)

UNIT-4 **(08 hrs)**

Ambiguity, Word sense Disambiguation: Context-based WSD Approaches, Knowledge based approaches, Supervised Learning of WSD, Bayesian Classification, Testing, K-Nearest Neighbour or Memory-based Learning, Bootstrapping, Bilingual Corpora, Unsupervised methods of WSD.

Machine Translation: Introduction, Problems in Machine Translation, Characteristics of Indian Languages, Machine translation approaches, Direct Machine translation, Rule-based machine translation, Corpus based MT, Semantic or Knowledge-based MT systems, Translation involving Indian Languages.
(Text Book-1: 5.4,5.5.2,8.1-8.9)

UNIT-5 **(08 hrs)**

Natural Language Generation: Introduction, Architectures of NLG systems, Generation tasks and representations (Except "Approach based on functional unification grammar").
Other Applications of NLP: Introduction, Information Extraction, Automatic Text Summarization, Question-Answering System.
Lexical Resources: WordNet, FrameNet, Stemmers, POS taggers, Research Corpora.

Disambiguating word sense using Wordnet, NLP in a Search Engine.
(Text Book-1: 7.1-7.3, 11.1-11.4, 12.2-12.6)
(Text Book-2: 4.8,5.6)

Course outcomes:
On successful completion of this course, students will be able to:

1. Design finite state automata and context free grammars for word level and syntax level analysis respectively.
2. Describe and Apply N-grams Language model to predict the next word in the text sequence.
3. Outline Natural Language Generation techniques and various lexical resources.
4. Describe basics of NLP and identify various applications of NLP like Machine Translation, information Retrieval, etc.
5. Describe the use of various NLP techniques like POS tagging, WSD etc. for text processing and develop python code for the same.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Natural Language Processing and Information Retrieval	Tanveer Siddiqui, U S Tiwary	Oxford University Press	2nd Edition, 2010.
2	Natural Language Processing Recipes Unlocking Text Data with Machine Learning and Deep Learning using Python	Akshay Kulkarni, Adarsha Shivananda.	Apress	2019
Reference Books				
1	Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition,	Daniel Jurafsky and James H Martin	Prentice Hall,,	Low Price Edition, 2000.
2	Foundations of Statistical Natural Language Processing	Christopher D. Manning	MIT Press	1999.

3	Natural language processing with Python	Steven, Ewan Klein, and Edward Loper	O'Reilly Media	1st Edition, 2009.

Course Articulation matrix(CO-PO and CO-PSO mapping)

Course Outcomes	PROGRAMME OUTCOMES												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO1	2		2											2	
CO2	2		2											2	
CO3	2		2											2	
CO4	1		1											2	
CO5	2		2											2	
Overall CO	2		2											2	

B.E COMPUTER SCIENCE & ENGINEERING Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – VII			
INTERNET OF THINGS			
Course Code	**N7CSPE32**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03
Lecture Hours	40 Hrs	Practical Hour	-

Course objectives: This course will enable students to:

1. To identify sensors, actuators, and the importance of IoT Processing technologies
2. To determine salient features, technologies, requirements associated with IoT connectivity and IoT communication protocols
3. To apply security principles for securing Operational and Informational Technology (OT and IT) in IoT environment
4. To do analytics for IoT generated data using open source tools
5. To apply the knowledge in real time by learning the case studies of IoT

UNIT-1 **(07 hrs)**

IoT Sensing and Actuation: Sensors, Sensor characteristics, Sensorial Deviations, Sensing Types, Sensing Considerations, Actuators, Actuators Types, Actuator Characteristics
(Text Book 1: Chapter 5)

IoT Processing Topologies and Types: Data Format, Importance and processing in IoT, Processing Topologies, IoT Device Design and Selection Considerations, Processing Offloading
(Text Book 1 : Chapter 6)

UNIT-2 **(09 hrs)**

IoT Connectivity Technologies: IEEE 802.15.4, Zigbee, Thread, ISA 100.11A, Wireless HART, RFID, NFC, DASH7, Z-Wave, Weightless, Sigfox, LoRA, NB-IoT, Wifi, Bluetooth
(Text Book 1: Chapter 7)

IoT Communication Technologies: Infrastructure Protocols – Internet Protocol version 6, 6LowPAN, QUIC, Micro Internet Protocol, Nano Internet Protocol, Data Protocols – MQTT, MQTT-SN, CoAP, AMQP, XMPP, SOAP, REST, WebSocket Identification Protocols.
(Text Book 1: Chapter 8)

UNIT-3 **(08 hrs)**

IoT Application Transport Methods: Application Layer not present, SCADA, Generic Web based Protocols, IoT Application Layer Protocols (Text Book 2: Chapter 6)

Securing IoT: Common Challenges in OT Security – Erosion of Network Architecture, Pervasive Legacy Systems, Insecure Operational Protocols, Other Protocols, Device Insecurity, Dependence on External Vendors, How IT and OT Security Practices and Systems vary, Formal Risk Analysis Structures: OCTACE and FAIR, The Phased Application of Security in an Operational Environment
(Text Book 2: Chapter 8)

UNIT-4 **(08 hrs)**

Data Analytics for IoT: Apache Hadoop, Using Hadoop Map Reduce for Batch Data Analysis, Apache Oozie, Apache Spark, Apache Storm, Using Apache Storm for Real time Data Analysis
(Text Book 3 – Chapter 10)

UNIT-5 **(08 hrs)**

Case Studies for IoT:
Agricultural IoT (Text Book 1: Chapter 12)
Vehicular IoT (Text Book 1: Chapter 13)
Health Care IoT(Text book 1: Chapter 14)

Paradigms, Challenges and Future: Evolution of new IoT paradigms, Challenges Associated with

IoT, Emerging pillars of IoT (Text book 1: Chapter 15)

Course outcomes:

On successful completion of this course, students will be able to:

1. To Characterize sensors, actuators, their associated multi-faceted considerations and to determine the importance of IoT Processing technologies
2. To identify, understand and determine salient features, technologies, requirements associated with IoT connectivity and IoT communication protocols
3. To apply the transport methods and handling of IoT application data; To synthesize the principles of securing Operational and Informational Technology (OT and IT)
4. To synthesize data analytics for IoT
5. To analyze the application of IoT in agriculture, vehicles and health care and to learn the future trends of IoT

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Introduction to IoT,	Sudip Misra, Anandarup Mukherjee, Arijit Roy	Cambridge University Press,	1st Edition, 2021
2	IoT Fundamentals - Networking Technologies, Protocols, and Use Cases for the Internet of Things,	David Hanes, Gonzalo Salgueiro et al	Press, Publishers, Pearson	Cisco 4th Edition, 2019
3	Internet of Things – a hands on Approach	Arshdeep Bahga, Vijay Madisetti	Universities Press	1st edition, 2015
Reference Books				
1	Precision: Principles, Practices and Solutions for the Internet of Things	Timothy Chou	Publisher	2nd Edition, 2020
2	Exploring Raspberry Pi	Dr Derek Molloy	Publisher	1st Edition, 2016
3	INTERNET OF THINGS (IOT): Architecture and Design Principles	Rajkamal		2nd Edition, 2022

Course Articulation matrix(CO-PO and CO-PSO mapping)

Course Outcomes	PROGRAM OUTCOMES												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO1	2														2
CO2		2													2
CO3		2													2
CO4		2													2
CO5		2							2	2					2
Overall CO	2	2							2	2					2

Program articulation matrix:

Course Outcomes	PROGRAM OUTCOMES												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
	2	2							2	2					2

Degree of compliance **1**: Low **2**: Medium **3**: High

B.E COMPUTER SCIENCE & ENGINEERING
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – VII

GENERATIVE AI AND PROMPT ENGINEERING

Course Code	**N7CCSPE01**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03
Lecture Hours	40 Hrs	Practical Hour	-

Course objectives: This course will enable students to:

- To provide a comprehensive understanding of generative AI models and their applications.
- To explore the key components and workings of LangChain and its comparison with other frameworks.
- To develop skills for building and implementing chatbots using advanced retrieval and vector techniques.
- To introduce the fundamentals and importance of prompt engineering in AI communication.
- To equip students with best practices and strategies for writing effective prompts and addressing common challenges in prompt engineering.

UNIT-1 **7 Hours**

Introducing generative AI: Generative models, Understanding LLMs, What is a GPT?, Other LLMs, Major players, Working of GPT models, Pre-training, Tokenization, Scaling, Conditioning, text-to-image models, LangChain for LLM Apps: Going beyond stochastic parrots, limitations of LLMs, mitigating LLM limitations, LLM app, LangChain.

UNIT-2 **8Hours**

Exploring key components of LangChain, chains, agents, memory, tools, working of LangChain, Comparing LangChain with other frameworks, Summarizing information, Basic prompting Prompt templates, Building a Chatbot like ChatGPT: What is a chatbot?, Understanding retrieval and vectors, Embeddings, Vector storage, Vector indexing, Vector libraries, Vector databases, Loading and retrieving in LangChain, Document loaders, Retrievers in LangChain, kNN retriever, PubMed retriever, Custom retrievers

UNIT-3 **9Hours**

Implementing a chatbot, Document loader, Vector storage, Memory, LLMs for Data Science, The impact of generative models on data science, Automated data science, Data collection, Visualization and EDA, Preprocessing and feature extraction, The Future of Generative Models, The current state of generative AI, Challenges, Trends in model development, Artificial General Intelligence, Economic consequences, Creative industries and advertising, Education, Law, Manufacturing, Medicine, Military, Societal implications.

UNIT-4 **8 Hours**

Introduction to ChatGPT, Overview of Large Language Models, Output Formats Generated By ChatGPT, Use Cases for ChatGPT, Differences Between ChatGPT and Web Search, Introduction to Prompt Engineering: Definition of Prompt Engineering, Importance of Prompt Engineering in AI Communications, Overview of the Different Types of Prompts, Understanding the Foundation of Prompt Engineering, Power Up Your Prompts With Effective Verbs, Elevate Your Prompts with Nuances of Tone, Progressive Experimentation for Refining Prompts, Do You Need Programming Skills to Become a Prompt Engineer?

UNIT-5 **8 Hours**

Writing Effective Prompts, Key Attributes of Good Prompt Writing, Tips for Getting the Most Out of Prompt Responses, Best Practices in Prompt Engineering: Understanding the Nuances of Language & Tone, Testing & Iterating Prompts for Improved Performance, Incorporating Feedback from AI Models to Refine Prompts, Enhancing Reliability of Responses, Give More "Think Time" to the Model, Staying Up to Date with the Latest Advancements, Tips for Getting the Most Out of Prompt Responses, Challenges in Prompt Engineering: Addressing Common Challenges & Pitfalls, Strategies for Improving Prompt Effectiveness, Ethical Considerations in Prompt Engineering.

Course outcomes:
At the end of the course the student will be able to:

CO1: Gain a solid understanding of generative AI models, including large language models and text-to-image models.
CO2: Utilize LangChain for developing advanced LLM applications and understand its components and functionalities.
CO3: Develop practical skills in implementing chatbots, managing vector storage, and employing LLMs for data science.
CO4: Understand the principles of prompt engineering and learn how to design effective prompts for various AI applications.
CO5: Apply best practices in prompt engineering, address challenges, and incorporate ethical considerations in their work.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Generative AI with LangChain	Ben Auffarth	Packt Publishing Ltd.	1st Edition, 2023
2	Demystifying Prompt Engineering	Harish Bhat	Harish Bhat	1st Edition, 2023
Reference Books				
1	"Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play.	David Foster	O'Reilly Media	2nd Edition, 2023
2	Prompt Engineering for Generative AI: Future-Proof Inputs for Reliable AI Outputs	James Phoenix, Mike Taylor	O'Reilly Media	1st Edition, 2024

Course Articulation matrix(CO-PO and CO-PSO mapping)

Course Outcomes	PROGRAM OUTCOMES												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO1	2													2	
CO2			2											2	
CO3			2											2	
CO4			2		2									2	
CO5	2				2									2	
Overall CO	2		2		2									2	

B.E COMPUTER SCIENCE & ENGINERRING
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – VII

REAL TIME BIG DATA ANALYTICS

Course Code	**N7CCSPE02**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03
Lecture Hours	40 Hrs	Practical Hour	-

Course objectives: The course will enable students to

1. **Describe** the basic paradigms , data model , evolution for Big Data (L2).
2. **Explain** the importance of a serialization framework and limitations of serialization frameworks for Big Data (L2)
3. **Analyze** how the data is stored on the batch layer
4. **Design** of the batch layer starting from ingesting new data to computing batch views .
5. **Illustrate** how to build the serving layer for Bigdata .
6. **Describe** the real time views of Cassandra's data model for Bigdata
7. **Demonstrate** how to implement the concepts of queuing and stream processing using real-world tools.

UNIT-1 **(08 hrs)**

A new paradigm for Big Data: Scaling with a traditional database - NoSQL is not a panacea - First principles - Desired properties of a Big Data system - The problems with fully incremental - Lambda Architecture - Recent trends in technology - Example application: SuperWebAnalytics.com.

Data model for Big Data: The properties of data - The fact-based model for representing data - Graph - A complete data model for SuperWebAnalytics.com.

Data model for Big Data - illustration: Why a serialization framework? - Apache Thrift - Limitations of serialization frameworks.

UNIT-2 **(08 hrs)**

Data storage on the batch layer: Storage requirements for the master dataset - Choosing a storage solution for the batch layer - How distributed file systems work - Storing a master dataset with a distributed file system - Vertical partitioning - Low-level nature of distributed file systems - Storing the SuperWebAnalytics.com master dataset on a distributed file system

Data storage on the batch layer – Illustration: Using the Hadoop Distributed File System - Data storage in the batch layer with Pail - Basic Pail operations - Serializing objects into pails - Batch operations using Pail - Vertical partitioning with Pail - Pail file formats and compression – Summarizing the benefits of Pail - Storing the master dataset for SuperWebAnalytics.com

Batch layer: Computing on the batch layer, Re-computation algorithms vs. incremental algorithms, Scalability in the batch layer, MapReduce: a paradigm for Big Data computing, Low-level nature of MapReduce, Pipe diagrams: a higher-level way of thinking about batch computation

UNIT-3 **(08 hrs)**

Batch layer: Illustration: An illustrative example - Common pitfalls of data-processing tools - An introduction to JCascalog – Composition

Batch layer - Architecture and algorithms: Design of the SuperWebAnalytics.com batch layer - Workflow overview - Ingesting new data - URL normalization - User-identifier normalization - Deduplicate pageviews - Computing batch views

Batch layer: Implementation: Starting point - Preparing the workflow - Ingesting new data - URL normalization - User-identifier normalization - Deduplicate pageviews - Computing batch views.0^794PJY6HT\\]][piuoyi

UNIT-4 **(08 hrs)**

Serving layer: Performance metrics for the serving layer - The serving layer solution to the normalization/denormalization problem - Requirements for a serving layer database - Designing a serving layer for SuperWebAnalytics.com - Contrasting with a fully incremental solution.

Serving layer: Illustration: Basics of ElephantDB - Building the serving layer for SuperWebAnalytics.com.

Realtime views : Computing realtime views - Storing realtime views - Challenges of incremental computation - Asynchronous versus synchronous updates - Expiring realtime views.

UNIT-5 **(07 hrs)**

Realtime view – Illustration: Cassandra's data model 220 - Using Cassandra.

Queuing and stream processing: Queuing, Stream processing, Higher-level, one-at-a-time stream processing, SuperWebAnalytics.com speed layer

Queuing and stream processing: Illustration: Defining topologies with Apache Storm, Apache Storm clusters and deployment, Guaranteeing message processing

Course outcomes:

On successful completion of this course, students will be able to:

1. Apply the basic knowledge related to data models to explain its elements, its analytics, its usage in business context.
2. Illustrate data storage on the batch layer using the Hadoop Distributed File System
3. Design and Develop batch layer to the solution of various real world application problems in the context of real time data
4. Identify the requirement of Computing storing real time views in Cassandra's data model
5. Implement the concepts of queuing and stream processing using real-world tools.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Big Data - PRINCIPLES AND BEST PRACTICES OF SCALABLE REAL-TIME DATA SYSTEMS	NATHAN MARZ with JAMES WARREN	Manning Publications	2015 Edition
2	Spark in Action	Petar Zečević Marko Bonaći	Manning Publications	Nov 2016 Edition
Reference Books				
1	Hadoop: The Definitive Guide	Tom White	O'reilly Media	4th Edition,2015
2	Big Data and Analytics	SeemaAcharya,SubhashiniChellappan	Wiley India Publications,	May 2015
3	Big Data Black book	D T Editorial Services	Dream tech press	2016 Edition

Course Articulation matrix(CO-PO and CO-PSO mapping)

Course Outcomes	PROGRAMME OUTCOMES												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO1	3														2
CO2					2										2
CO3			3												3
CO4		2			2										2
CO5					2										2
Overall CO	3	2	3	-	2	-	-	-	-	-	-	-	-	-	3

Program articulation matrix:

Course	PROGRAMME OUTCOMES												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
BIG DATA(RCSE32)	3	2	3	-	2	-	-	-	-	-	-	-	-	-	3

Degree of compliance **1**: Low **2**: Medium **3**: High

B B.E COMPUTER SCIENCE & ENGINERRING
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – VII

Research Methodology and IPR

Course Code	**N7CCA01**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(2:0:0)	SEE Marks	50
Credits	3	Exam Hours	3
Lecture Hours	40 hrs	Practical Hour	-

UNIT 1 **6 Hours**

Introduction: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT 2 **5 Hours**

Research Problem: Effective literature studies approaches, analysis Plagiarism, and Research ethics.

UNIT 3 **5 Hours**

Technical Writing: Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT 4 **8 Hours**

Intellectual Property Rights: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT..

UNIT 5 **8 Hours**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Course outcomes:

On successful completion of this course, students will be able to:

1. Identify based on the knowledge the basics of research and its types.
2. Apply knowledge to write Literature Review, Technical Reading, Attributions and Citations
3. Practice the knowledge of Ethics in Engineering Research
4. Apply the concepts of Intellectual Property Rights in engineering
5. Apply IPR knowledge for the granting patents and its procedure for new innovative product for grants.

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3		2								3	3		
CO2	3	3	3		2								3	3		
CO3	3	3	3		2								3	3		
CO4	3	3	3		2								3	3		
CO5	3	3	3		2								3	3		

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Research methodology: an introduction	Wayne Goddard and Stuart Melville	Juta Academic Lt.D.	2nd Edition, 201 ISBN 9780702156601
2	Research methodology: an introduction for science & engineering students,	Stuart Melville and Wayne Goddard	Juta Academic	2nd Edition,
	Research Methodology: A Step by Step Guide for beginners,	Ranjit Kumar	SAGE Publications India Pvt Ltd,	4th Edition, 202 ISBN: 9789351501336
Reference Books				
1	Intellectual Property Rights Under WTO", , 2008	T. Ramapp	S. Chand	
2	Intellectual Property in New Technological Age",	Robert P. Merges, Peter S. Menell, Mark A. Lemley		2016